10/580825
IAP9 Rec'd PCT/PTO 26 MAY 2006

A METHOD AND DEVICE FOR CONTROLLING DRILLING FLUID PRESSURE

This invention regards a method of controlling drilling fluid pressure. More particularly, it regards a method of controlling the drilling fluid pressure in an underground borehole during drilling of wells from a fixed offshore platform. The invention also regards a device for practicing the method.

During drilling operations, e.g. for petroleum production, the pressure head of drilling fluid present in the borehole and up to the platform, may cause the liquid pressure in the lower portion of the borehole to become too high.

Excessive drilling fluid pressures may result in the drilling fluid causing undesirable damage to the formation being drilled, e.g. through drilling fluid penetrating into the formation.

The formation may also include special geological formations (saline deposits etc.) that require the use of special drilling fluid in order to stabilise the formation.

According to prior art it is difficult to reduce the specific gravity of the drilling fluid in order to reduce the pressure to an acceptable level. In many cases it has proven difficult to achieve sufficient reduction in the specific gravity of the drilling fluid without causing an unacceptable degree of change in the physical properties of the drilling fluid, such as viscosity.

It is known to dilute the drilling fluid in a riser in order to reduce the drilling fluid pressure, see US 6536540.

When drilling from floating installations, it is also known to reduce the drilling fluid pressure in the well and the weight of the riser by pumping drilling fluid out of the riser at a level below the surface of the sea. Thus US patents 4063602 and 4291772 concern drilling vessels provided with a return pump for drilling fluid, wherein the drilling fluid is pumped out of the riser immediately above the seabed.

When using prior art it is difficult to monitor the volumetric flow in the borehole, as the annulus above the drilling fluid in the liner, or alternatively riser, is filled with gas, typically air. This gas-filled annulus may fill up with or become drained of drilling fluid without being easily observed.

The object of the invention is to remedy or reduce at least one of the disadvantages of prior art.

The object is achieved in accordance with the invention, by the characteristics stated in the description below and in the following claims.

When drilling from fixed platforms (drilling devices), a conductor is first driven into the seabed. When drilling a borehole from a fixed drilling device, drilling fluid is pumped through a drill string down to a drilling tool. The drilling fluid serves several purposes, of which one is to transport drill cuttings out of the borehole. Efficient transport of drill cuttings is conditional on the drilling fluid being relatively viscous.

The drilling fluid flows back through the annulus between the borehole wall, the liner mentioned above and the drill string, and up to the drilling rig, where the drilling fluid is treated and conditioned before being pumped back down to the borehole. In many cases, this will result in a head of pressure that is undesirable.

By coupling a pump to the liner near the seabed as described above, the returning drilling fluid can be pumped out of the annulus and up to the drilling rig. According to the invention the annular volume above the drilling fluid is filled with a riser fluid. Preferably, the density of the riser fluid is less than that of the drilling fluid.

The drilling fluid pressure at the seabed may be controlled from the drilling rig by selecting the inlet pressure to the pump. The height H_1 of the column of drilling fluid above the seabed depends on the selected inlet pressure of the pump, the density of the drilling fluid and the density of the riser fluid, as the inlet pressure of the pump is equal to:

$$P = H_1 \times \gamma_b + H_2 \times \gamma_s$$

Where:

γ_b = the density of the drilling fluid

H_2 = the height of the column of riser fluid

γ_s = the density of the riser fluid

H_1 and H_2 together make up the length of the riser section from the seabed and up to the deck of the drilling rig.

Filling the liner annulus with a riser fluid allows continuous flow quantity control of the fluid flowing into and out of the borehole. Thus it is relatively easy to detect e.g. drilling fluid flowing into the drilling formation.

It is furthermore possible to maintain a substantially constant drilling fluid pressure at the seabed, also when the drilling fluid density changes.

Choosing another inlet pressure to the pump will immediately cause the heights H_1 and H_2 to change according to the new pressure.

If so desired, the outlet from the annulus to the pump can be arranged at a level below the seabed, by coupling a first pump pipe to the annulus at a level below the seabed.

In order to prevent the drilling fluid pressure from exceeding an acceptable level, e.g. in the case of a pump trip, the riser may be provided with a dump valve. A dump valve of this type can be set to open at a particular pressure for outflow of drilling fluid to the sea.

The following describes a non-limiting example of a preferred method and device illustrated in the accompanying drawings, in which:

Figure 1 is a schematic view of a fixed drilling rig provided with a pump for the returning drilling fluid, the pump being coupled to the riser section near the seabed and the riser section being filled with a fluid of a different density than that of the drilling fluid; and

Figure 2 is similar to Figure 1, but here the drilling fluid fills a greater part of the riser section.

In the drawings reference number 1 denotes a fixed drilling rig comprising a support structure 2, a deck 4 and a derrick 6. The support structure 2 is placed on the seabed 8 and projects above the surface 10 of the sea.

A riser section 12 of a liner 14 extends from the seabed 8 up to the deck 4, while the liner 14 runs further down into a borehole 15. The riser section 12 is provided with required well head valves (not shown).

A drill string 16 projects from the deck 4 and down through the liner 14.

A first pump pipe 17 is coupled to the riser section 12 near the seabed 8 via a valve 18 and the opposite end portion of the pump pipe 17 is coupled to a pump 20 placed near the sea-bed 8. A second pump pipe 22 runs from the pump 20 up to a collection tank 24 for drilling fluid on the deck 4.

A tank 26 for a riser fluid communicates with the riser section 12 via a connecting pipe 28 at the deck 4. The connecting pipe 28 has a volume meter (not shown). Preferably, the density of the riser fluid is less than that of the drilling fluid.

The power supply to the pump 20 is via a cable (not shown) from the drilling rig 1 and the pressure at the inlet to the pump 20 is selected from the drilling rig 1. The pump 20 may optionally be driven hydraulically by means of oil that is circulated back to the drilling rig or by means of water that is dumped in the sea.

The drilling fluid is pumped down through the drill string 16 in a manner that is known *per se*, returning to the deck 4 via an annulus 30 between the liner 14 and the drill string 16. When the pump 20 is started, the drilling fluid is returned

from the annulus 30 via the pump 20 to the collection tank 24 on the deck 4.

Riser fluid passes from the tank 26 into the annulus 30 in the riser section 12. The height H_1 of the column of drilling fluid above the seabed 8 adjusts according to the selected inlet pressure of the pump 20, as described in the general part of the description.

The volume of riser fluid flowing into and out of the tank 26 is monitored, making it possible to keep a check e.g. on whether drilling fluid is disappearing into the well formation, or gas or liquid is flowing from the formation and into the system.

The invention makes it possible by use of simple means to achieve a significant reduction in the pressure of the drilling fluid in the borehole 15.

Figure 2 shows a situation where a higher inlet pressure has been selected for the pump, and where the heights H_1 and H_2 of the fluid columns have changed relative to the situation shown in Figure 1.